Sunspot dynamics and the heating of coronal loops

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The sub-surface dynamics of the magnetic field in sunspots plays an important role in providing energy for heating the corona. available. We present results from a hybrid model of coronal loop heating and sunspot dynamics, which keeps the two regimes distinct but allows a "transfer of information" between them. Specifically, the dynamics of the magnetoconvection generates a Poynting flux which we assume provides the necessary energy to heat the coronal loops.

The sub-surface model used describes magnetoconvection in a 2D axisymmetric geometry and considers the time development of the overlying coronal field. This model diverges from the standard practice of assuming constant temperature and vertical magnetic field conditions at the top surface by adopting a radiative potential condition. Extrapolation of the surface boundary conditions results in a coronal field configuration filled with plasma heated to coronal temperatures by the Poynting flux entering the coronal volume. The time dependence in the coronal loops is assumed to proceed via a series of equilibria in which the temperature and density distributions are in quasi-static equilibrium.

This combination of a sunspot model heating input allows us to explore a broad class of heating paradigms.